To The Point
Dust Hazards Analysis (DHA)

Fire and explosion risks are generally thought to be associated with the handling of flammable liquids and gases. However, industries that manufacture, handle, or generate particulate solids can produce explosions and fire hazards from combustible dust. If you process or handle products that make dust, they can become combustible in the proper environment.

Vulnerable Industries

Industries such as food and grain, mining, and plastics manufacturing can be particularly vulnerable to combustible dust incidents. Between 2006 and 2017, 111 combustible dust incidents resulted in 66 worker deaths and 337 injuries in the United States, according to data from the Chemical Safety Board. Aside from injuries and loss of life, these events also resulted in property and production losses.

With dust-related explosions historically resulting in extensive property losses and casualties, the National Fire Protection Association (NFPA) 652: Standard on the Fundamentals of Combustible Dust was developed to provide a more uniform approach to several other dust-related fire protection standards. Consequently, manufacturing operations were required to complete a Dust Hazards Analysis (DHA) by September 7, 2020 or be able to show strong progress toward completion.[2] Then, in late 2024, NFPA 660: Standard for Combustible Dusts and Particulate Solids was developed for the purpose of consolidating the requirements of NFPA 652 and several other related standards into one central resource.

Examples of industries that handle combustible particulate solids, either as a process material or as a fugitive or nuisance dust, include but are not limited to the following:

- Agricultural, chemical, and food commodities
- Fiber and textile materials
- Forest and furniture products
- Metal processing
- Paper products
- Pharmaceuticals
- Resource recovery operations (tires, municipal solid waste, metal, paper, or plastic recycling)
- Wood, metal, or plastic fabrication[1]

What is a DHA?

NFPA defines a DHA as "A systematic review to identify and evaluate the potential fire, flash-fire, and explosion hazards associated with the presence of one or more combustible particulate solids in a process or facility." NFPA 660 states that a DHA should provide the following:

- Identification and evaluation of the process or facility areas where fire, flash fire, and explosion hazards exist
- Where such hazards exist, identification and evaluation of specific fire, flash-fire, and explosion scenarios shall include the following:
  - Identification of safe operating ranges
  - Identification of the safeguards that are in place to manage fire, flash fire, and explosion events
  - Recommendation of additional safeguards where warranted, including a plan for implementation[3]

Per NFPA 660, the DHA shall be performed or led by a qualified person who possesses documented experience and education regarding methods for performing a DHA and the assessment and identification of mitigation or elimination options for the fire, flash fire, explosion, and related hazards of the specific type or types of combustible dusts involved in the facility.[3] The method(s) must address preventative and protective safeguards in the form of key risk consulting methods, including protective engineering risk controls (venting, suppression, containment, etc.) and preventative administrative risk controls (good housekeeping, hot work permit programs, etc.). Limiting combustible dust (fuel), eliminating ignition sources, and reducing oxygen concentrations will help mitigate the risk.[1]

The goal of a DHA is to identify all the hazards in a facility associated with combustible dust. The Imperial Sugar Refinery explosion in 2008 was the result of unknown, unidentified hazards. A conveyor enclosure created the necessary confinement for sugar dust (in suspension) that was leaking and dispersed from silo outlets. An overheated bearing inside the enclosure is believed to have been

the ignition source. This initial explosion ignited several secondary explosions due to fugitive dust accumulation and poor housekeeping. This event resulted in 14 deaths and injured 38 others, including 14 with severe and life-threatening burns.[5]

The severity of an Explosion: Kst & Pmax

Kst is the deflagration index of a dust cloud. In simple terms, Kst is a measure of how fast an explosion happens. The higher the Kst value, the quicker the pressure of an explosion will build. Dust is categorized into hazard classes based on its Kst value, as shown below (NFPA 68: Standard on Explosion Protection by Deflagration Venting).[4,6]

Hazard Class	Kst	Pmax
ST1	< 200	10
ST2	201-300	10
ST3	> 301	12

Pmax is defined in NFPA 68 as the maximum pressure developed in a contained deflagration of an optimum mixture and measures how strong the explosion is.

Although ST1 is considered the weakest explosive dust category, an ST1 dust generates sufficient power to cause a flash fire, compromise containment on a piece of equipment, or blow out the walls of a building. Grains, Sugar, Coal, PVC, Flour, Soaps, Talc etc., are all considered ST Class 1 dust. Only one of the ten combustible dust investigations completed by the Chemical Safety Board reported fuel sources above ST1.[7] So even the lowest hazard class of combustible dust is historically responsible for the largest losses.

Properties Used to Determine Where Hazards Exist

There are environmental properties within your facility and processes that are important to address in a Dust Hazards Analysis. These include:

- **Minimum Explosible Concentration (MEC):** Minimum amount of dust suspended in the air that will support an explosion
- **Minimum Ignition Energy (MIE):** Minimum amount of energy required to cause flame propagation when released at a point in a dust cloud
- **Minimum Ignition Temperature (MIT):** Minimum temperature required to ignite your dust comes in two forms: MIT for a dust cloud and MIT for a dust layer. MIT for a dust cloud is the temperature of the surrounding air required to ignite a dust cloud. MIT for a dust layer is the temperature of a surface where dust may accumulate that will cause the dust to ignite.[4]

These properties assist when considering options to reduce combustible dust hazards. These properties help determine the conditions under which a hazard exists and at what point a hazard has been effectively reduced. MEC, MIE, and MIT help determine what parts of your process or areas of your facility are potential hazards and define what must be achieved to reduce those hazards.[4]

A Dust Hazards Analysis is not a static process, and NFPA 660 requires that the DHA be reviewed and updated at least every five years. The reasoning is the anticipated changes in operations and processes.[3]

Who should conduct the DHA?

Chubb Risk Consulting experience has shown that a company's in-house expertise concerning processes and operations usually lacks the level of knowledge and proficiency on combustible dust hazards to conduct a Dust Hazards Analysis without support.

The DHA should include someone well- versed in combustible dust hazards and control technologies. The DHA must be adequately documented and periodically updated to reflect changes introduced. Consulting firms provide these services and can serve as DHA team leaders if you wish to integrate your company's expertise with a dust hazard consultant.

While most clients have in-house expertise concerning their processes and operations, it is strongly recommended that clients utilize such outside resources. It is not uncommon for even Fortune 200 companies to rely on external consultants for Dust Hazards Analysis.

Learn More & Connect

For more information on protecting your business, contact your local risk engineer, visit the Chubb Risk Consulting Library, or check out www.chubb.com/riskconsulting.

1. "What the Required Dust Hazard Analysis Means for your Team", www.westex.com/blog/what-the-required-dust-hazard-analysis-means- for-your-team/
2. **NFPA 652:** Standard on the Fundamentals of Combustible Dust (2019)
3. **NFPA 660:** Standard for Combustible Dusts and Particulate Solids
4. "What is Dust Hazard Analysis?", www.hallam-ics.com/blog/what-is-a-dust-hazard-analysis-dha
5. Sugar Dust Explosion and Fire Investigation Report, www.csb.gov/assets/1/20/imperial_sugar_report_final_updated.pdf?13902
6. **NFPA 68:** Standard on Explosion Protection by Deflagration Venting
7. "Is a ST Class 1 Dust Dangerous?", www.fauske.com/blog/is-a-st-class-1-dust-dangerous